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14. ABSTRACT

All-solid photonic bandgap fibers (PBGF) can be spectrally tailored to suppress amplified spontaneous emission (ASE) and stimulated Raman scattering (SRS). Furthermore, this type of fiber is attractive for realizing high-power narrow-linewidth amplifiers as large mode areas can be attained while maintaining single-mode operation. Notably, an Yb-doped PBGF with a core diameter of ~50 ?m and a calculated effective area of 1450 ?m2 was fabricated using the stack and draw technique (Figure 1). The microstructures in the cladding are comprised of germanium-

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Report Title

Large mode area Yb-doped photonic bandgap fiber lasers

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High-Power Narrow-Linewidth Large Mode Area Photonic Bandgap Fiber Amplifier

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ABSTRACT

All-solid photonic bandgap fibers (PBGF) can be spectrally tailored to suppress amplified spontaneous emission (ASE) and stimulated Raman scattering (SRS). Furthermore, this type of fiber is attractive for realizing high-power narrow-linewidth amplifiers as large mode areas can be attained while maintaining single-mode operation. Notably, an Yb-doped PBGF with a core diameter of ~50 µm and a calculated effective area of 1450 μm^2 was fabricated using the stack and draw technique (Figure 1). The microstructures in the cladding are comprised of germanium-doped silica. A low refractive index polymer coating provides a numerical aperture of 0.46 for pumping purposes. The absorption was estimated to be 1 dB/m at a pump wavelength of 976 nm. Approximately 11 m of this fiber was mounted on a cold spool possessing a diameter of 53 cm. The PBGF was pumped in a counter-propagating configuration using 976 nm diodes from Laserline. The master oscillator was a non-planar-ring oscillator (NPRO) operating at 1064 nm. The output of the NPRO was then coupled into a phase modulator for stimulated Brillouin scattering (SBS) suppression and then amplified using a multi-stage amplifier system manufactured by IPG. The phase modulation frequency was set at 400 MHz and the modulation depth was chosen such that three equal peaks corresponding to the carrier frequency and the two adjacent sidebands were generated. As much as 20 W were used to seed the PBGF. A plot of the signal power vs. pump power is shown in Figure 2. The output signal power obtained was 587 W; which represents to the best of our knowledge the highest power reported to date for a PBGF amplifier. The slope efficiency for this amplifier was ~70%. At the highest output power, there was little sign of SBS.

Keywords: Photonic bandgap fiber**,** Yb-doped fiber amplifiers, stimulated Brillouin scattering

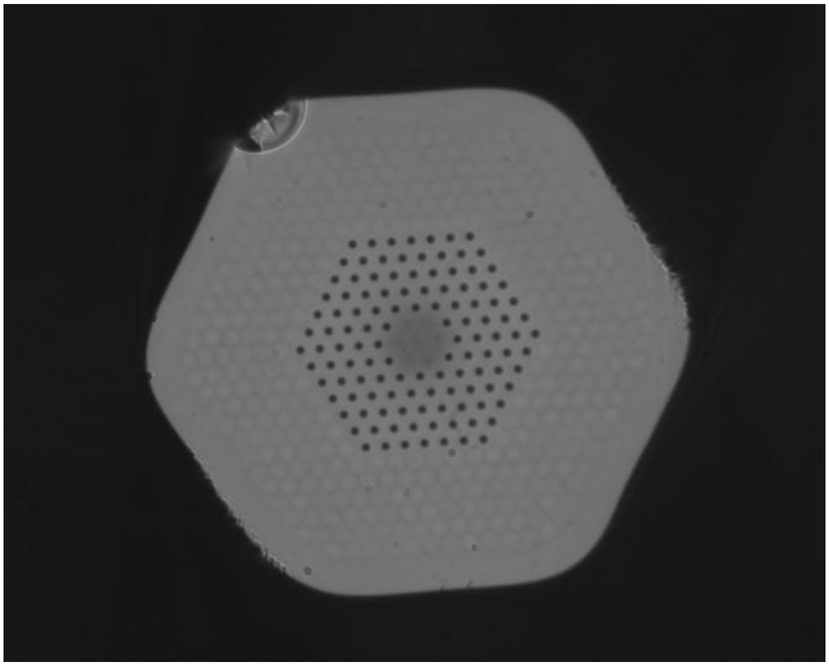

Fig. 1   Yb-doped all-solid PBGF with a core diameter of ~50 µm and a cladding diameter of ~400 µm. The core is comprised of 7 active rods.

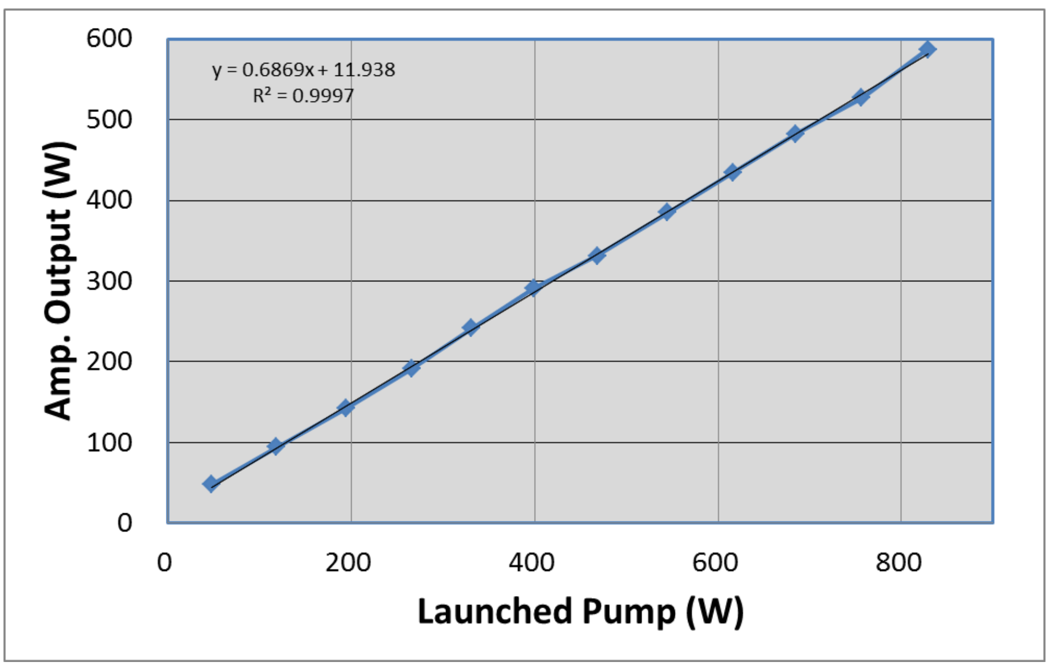

Fig. 2   Output signal power vs. launched power for PBGF amplifier. The slope efficiency is ~ 70%.